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WEITERE INFORMATIONEN OK

Friday, September 24, 2010

The Malthusian mystery

After a long stint of research and thought I have returned to share some of the results.

In the early 19th century the Reverend Thomas Malthus, foreshadowing Charles Darwin, wrote:

> Throughout the animal and vegetable kingdoms Nature has scattered the seeds of life abroad with the most profuse and liberal hand but has been comparatively sparing in the room and the nourishment necessary to rear them. The germs of existence contained in this earth if they could freely develop themselves would fill millions of worlds in the course of a few thousand years. Necessity, that imperious all pervading law of nature, restrains them within the prescribed bounds. The race of plants and the race of animals shrink under this great restrictive law and man cannot by any efforts of reason escape from it ... Wherever therefore there is liberty the power of increase is exerted and the superabundant effects are repressed afterwards by want of room and nourishment.

This is the Malthusian trap: any improvements in institutions, technologies, or any other improvement in labor productivity will over the course of a few generations increase the population until it once again flirts with subsistence levels.

Delayed marriage and plagues can delay or reverse such population growth for a time and produce higher than subsistence standards of living, but, with some small variations (see diagram below), eventually our Darwinian proclivity to procreate will return our descendants back to subsistence levels.

But just as Malthus was writing, his Great Britains were becoming the first living things to ever break free of the Malthusian trap. As a result, in the 21st century the developed world has both populations *and* standards of living never before achieved.

We can picture the progress of civilization in Malthusian terms. Click to enlarge and examine this schematic diagram:

Click to enlarge.

In this chart, the horizontal axis represents, on a logarithmic scale, the human population per area of land adjusted for natural (but not artificial) variability in its potential to support human food production. Such an adjusted area is typically called by ecologists a "global hectare" and my phrase "natural

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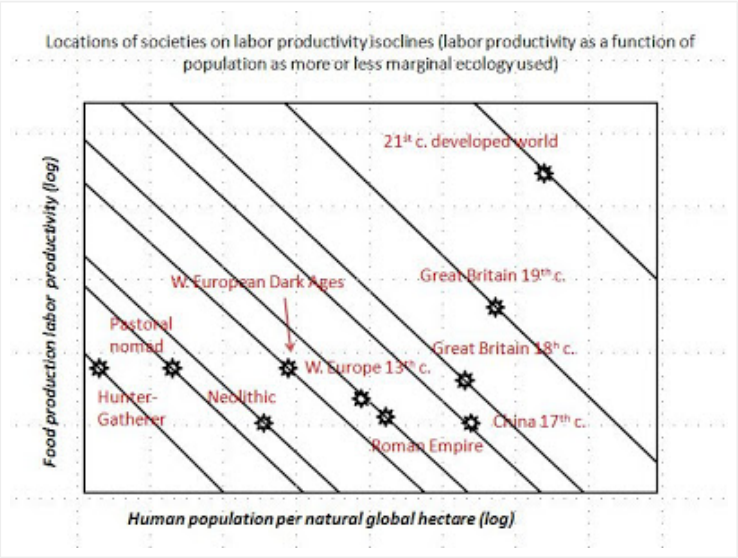

global hectare" represents a hypothetical measure of this independent of all human labor and capital improvements.

The vertical axis represents per capita nutrition derived, via human labor and capital, from this ecology.

The slope line or "labor productivity isocline" represents, intuitively speaking, a level of civilization. In other words, a level of technological and institutional progress. More specifically, it represents food production output per worker (productivity) adjusted for the marginality of ecology being used. As the isoclines move up and right, a given unit of labor is producing more human nutrition from the same global hectare. So our own 21st century agriculture is far more productive than 19th century British agriculture, which in turn was far more productive than medieval European agricultural, which in turn was more productive than Neolithic agriculture, which in turn was more productive than hunting and gathering.

As we move along a given isocline (a given "level of civilization" as just described) we experience the Malthusian tradeoff: more population per global hectare with lower nutrition, or less population per global hectare with higher nutrition. As we escape from the Malthusian trap, nutrition itself becomes satisfied and the left axis really represents a more general per capita income. Prior to escaping from the Malthusian trap, nutrition dominated the average human budget with fuel (mostly to cook food), clothing, shelter, etc. usually less than 20% of a personal budget or the overall economy.

A number of interesting patterns emerge from this kind of analysis. First, roving bandit societies such as hunter-gatherers and pastoral nomads tended to have lower population levels and higher per-capita nutrition than stationary bandit societies (settled agriculture). The Western European Dark Ages is an interesting intermediate case. This certainly suggests that most prior analyses of Malthusian tradeoffs, which have focused on pure economics, are very incomplete -- that security and politics play a crucial role, and not just in the trivial sense wars and other causes of mortality. There are good reasons of security of property and capital investments to expect this difference between roving and stationary bandits, as I hope to describe in future post(s).

The main question I hope to answer in forthcoming posts is: why did our escape from the Malthusian trap happen when and where it did, and not elsewhere? This will probably involve exploring a wide variety of technologies and institutions and especially the key factors of capital investment and security.

One obvious possible answer -- and the most likely reason humans will continue departing from the Malthusian trap for some time to come -- is birth control. But the British population up to the late 19th century was booming and seldom made effective use of birth control, so this can't explain Great Britain's initial escape from the Malthusian trap. A second answer is to invoke the industrial revolution. But this is a vague term and risks getting at least some of the causation backwards, as one of the factors enabling the industrial revolution was a large swelling of the British industrial work force because improving farm labor productivity meant that fewer farm workers could feed more people. And it neglects a third crucial factor, the transportation revolution. And it risks focusing on technology when institutional changes played a crucial role. All of which I hope to explore and to discuss with my readers.

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Meanwhile, for now I leave you with the following fascinating looks at London and Beijing early in the 20th century. See if you can spot a difference between the two societies which I find crucial. Indeed it is visually obvious and is implicit in a theme of the Chinese documentary. The internal combustion engines are irrelevant for our pre-20th-century purposes. Escape from the Malthusian trap was well underway by the early 19th century and the difference I have in mind had existed to some extent at least for many centuries. But if you're into more trivial pursuits see if you can spot the two "horseless carriages" on the London streets.

London in the 1900s:

Beijing and some other Chinese locales in the 1920s:

Posted by Nick Szabo at 9:36 PM

23 comments:

Anonymous said...

Why do the earlier revolutions in the source of our food not count as escapes from Malthusian traps?

I agree that the 18th - 19th c. revolution was qualitatively different from the others, because the proportion of people not involved in agriculture increased enormously. But that was true to a lesser extent of previous technological revolutions, and they were of course necessary prerequisites.

1:21 PM

nick said...

Good question. BTW I've clarified the graph by changing the Y-axis label to "food production labor productivity" from "per capita nutrition" which was misleading for the most recent two points.

The Malthusian trap is that the labor productivity of food production (which did correspond to per capita nutrition before the British revolution) tended to always return to subsistence levels or very close to it (the bottom third of the graph).

Going from hunter-gatherer to Neolithic, for example, while in terms of technology and institutions was an advance of civilization to more productive use of each natural global hectare, meant after the resulting population growth each individual worked longer to produce less food: food production labor productivity was lowered. That was the normal pathological Malthusian outcome: major advances in technology and institutions didn't greatly improve and indeed could lower per capita income in the long run.

The 19th century British were indeed revolutionary because they were the first living population self-sufficient in food to break far away from subsistence level food production labor productivity while at the same time increasing their population at about the maximum natural human rate.

In other words, not only did they radically move the isocline to the "northwest", as the Neolithic revolution had done, but unlike prior revolutions they (and we in the developed world today) have avoided the previous inevitable slide down the isocline to the low food production labor productivity seen in even advanced civilizations like China and the ancient Roman empire. This radical revolution in food production labor productivity is what allows us to have, as you point out, a vast population not themselves involved in food production, but working to satisfy "higher" needs, i.e. in industry, transportation, and a wide variety of services. Unlike any other organisms human or otherwise who have ever lived on this planet.

How the Brits (with much borrowing from others of course) did this is the mystery I hope to tackle in future posts.

2:33 PM

nick said...

Oops "northwest" should be "northeast" above, i.e. rightwards and upwards.

BTW, another illuminating fact to know is that hunter-gatherers, because of their higher food production labor productivity, spent more time than pre-British-revolution agriculture
doing things besides food production. But even hunter-gatherers spent a far higher fraction of their activity on food production than we in the developed world do. The Malthusian trap made large populations engaged in work other than food production impossible until the Brits (with plenty learned from the Dutch and others) figured out how to escape from the trap.

2:58 PM

Anonymous said...

Fascinating videos, that could spark a number of discussions.

But what struck me the most in the second one was a single sentence: "Water is not piped into houses, since it's cheaper to hire water-carriers."

Piping being mostly solved, the spirit of this sentence is (to an extent) still true in many eastern societies.

4:52 AM

Makarana said...

I'm amazed that horses can pull so many people and so much stuff. Considering that 100 hp is considered lame for a car.

4:31 PM

Anonymous said...

Nick,

The difference can be summed up by the 'quip', "A Chinese farmer carries his crop to market."

Another thing that stuck out was how well the carriages and pedestrians interacted. . .

8:28 PM

nick said...

The two Anonymi are within the region I've been thinking about. The difference that stuck out for me is the far greater number of horses hauling carriages and wagons in London whereas in China it was primarily other people who were being used in those roles. (Except in the more remote eastern areas where horses and camels were more available). Two little known but crucial facts are that Great Britain by the 19th century had a much larger number of draft animals per capita than the rest of the world (except for some of its former colonies like the U.S.), and made much greater use of the horse as opposed to the ox. As I will describe in future posts, this has deep connections to Malthusian economics, capital investment, the industrial revolution, and escaping from the Malthusian trap.

One of those connections is suggested by the second Anonymous. And as Makarana observes horses could actually get a surprising amount work of done considering how much "horsepower" we put in our machines these days. So it's misleading to think of the industrial revolution primarily in terms of steam-powered factories and railroads, and more illuminating to think of the economic

driver of England and Scotland leading up to the industrial revolution, and indeed well into the 19th century, as the horse. And to think about how Great Britain came to have so many horses.

I didn't see any obvious difference in how pedestrians and carriages interacted, I'll have to take another look for that.

P.S. it helps us all keep track of who's who if you choose pseudonyms, not "Anonymous", thanks.

12:31 AM

Leonard said...

Clearly, Britons in 1903 were using horses as motive power where the Chinese in 1920 were using people.

How is a horse different from a person in the Malthusian view? It does seem to me that one might look at the problem using something other than human population on the X axis. I.e. you could use human+horse population. This would skew your calculated numbers somewhat in that graph. If you count a horse as one person, then you would see horsepower-heavy societies drop down and right on their technological isoclines. I am not sure how large an effect this is, but you might think about it. (Also, a horse might count as two or more people, depending on what you feel "the" Malthusian trap is applying to: individuals? Horse/human biomass?)

Of course, horses are not people, so certainly treating them as not is defensible. In particular, not only can we control their increase (as versus humans, until the 20th century totalitarian state), we can eat them in bad times. So they are perhaps better seen as capital than labor.

1:21 PM

Leonard said...

One factor you did not mention was the access to colonizable land. (You did mention the "transportation revolution".) I think there may be a role for it. Consider labor prices: having a frontier will tend to keep up wage rates. So, it encourages all means of saving labor. The aforementioned horses is one, but also the invention of labor-saving and labor-replacing devices. That way lies industrial revolution.

Also, it is just a feeling, but my guess is that starting a technological revolution is easier and more likely when a society is not focused on culling population beyond its limits. It means less effort of elite classes spent in ideological work against the starving, as well as less internal policing.

1:33 PM

nick said...

Leonard, great comments. Tracking the population as something like X*horses + Y*draft oxen + human population is an interesting idea that crossed my mind. But what are X and Y? No good reason for them to be 1. Perhaps X could be 2.5, for a general estimate sometimes given for the value of farm work a horse can put out versus a human. Except that much of the labor is complementary rather than substitutable. Or perhaps a ratio of calories consumed, except that horses eat turnips, hay, and oats which are cheaper per calorie than human food. And also surprisingly complementary, not just competitive, which is a fascinating topic I hope to write about further.

Access to colonizable land is indeed important. I've thought of it in three ways, maybe there are more:

(1) Emigration to colonies (e.g. Americas) driving up labor costs, as you suggest.

(2) Reclamation of land in Great Britain. (i.e. farming new lands that had been wild or waste).

(3) Importation of food.

(3) started in Great Britain in the late 1840s but IMHO was not substantial until about the 1870s. My impression is that the effect of (1) was small and temporary and largely confined to the late 17th early 18th centuries, but I'd be happy to be shown wrong. Also it's partly a loss (capital investment in raising a child lost)as well as a Malthusian gain, so it seems to me difficult to evaluate the net effect, but I'd welcome ideas of how to do that.

(2) was very important. I will be lumping together with other improvements to land, since the land had already been nearby since ancient times.

Transportation makes (1) easier but an interesting idea that I think has just occurred to me is that it may make (2) easier also. Transportation increases the distance goods can be transported. What I have been thinking about for a while is that if you can for example now afford horses to transport goods to markets twice as far away, that makes four times as much farm area available to grow crops for the market instead of for local subsistence. Now it occurs to me that some land might be too marginal to farm for subsistence: it's only economical to farm for sale to a market. So better transportation would lead to more reclamation, which indeed there was quite a lot of during the 17th and 18th centuries. Reclamation was actually at least as important, and probably more important, than increasing yield/acre, until the 19th century(both were happening).

I've been doing extensive research and hope to be posting much more on these topics, and of course I greatly welcome these kinds of comments on them.

3:46 PM

5:18 PM

TGGP said...

Have you read Greg Clark's "A Farewell to Alms"? He has the same focus. He has also analogized low-productivity laborers today to the draft horses who found themselves useless.

Human labor also substituted for horses in czarist Russia.

1:35 PM

nick said...

TGGP, Clark inspired my recent research -- he recognized a crucial question that I had failed to recognize (the astounding nature and importance of the Malthusian mystery), and set forth some very interesting data, but IMHO got most of the answers wrong.

Other than that analogy he basically neglects to account for the horses, which accounted for much more "horsepower" on farms than either humans or steam by the latter half of the nineteenth century. The only scholar who appears to have recognized the crucial role of horses in increasing human labor productivity is E.A. Wrigley. But otherwise the topic seems to have been sadly neglected. Instead the industrial revolution has typically been seen as all about steam (never replaced more than a tiny fraction of horses on farms) and coal (important in industry but not on farms) and mechanisms (didn't play a big role in increasingly farm labor productivity until the mid 19th century, so can't explain the substantial progress in the Malthusian isocline before that time). This is not to say that there aren't some ways in which the agricultural revolution benefited from the industrial revolution, but they are much more subtle. This and some other neglected topics I find central to the agricultural/industrial revolution I have been researching and hope to cover in future posts.

3:46 PM

Leonard said...

I was surprised that in your estimation (1) would be minor compared to (2). I mean, my off-the-cuff guess is that the total land area of Britain is far less than the American frontier, almost as soon as colonization started. (Maybe that is not really true, though: Indians.) My impression was that the numbers were considerable... but, a quick googling suggests modest emigration rates in the 17th century (350000 in that century, for a population ending at ~5 million), and lower rates in the 18th (80,000 from 1700 to 1775), as population rose from 5 million to 8 million or so. So, I guess you're right... the 17th century rate is just 3500 per year, so it might have averaged .1% of the pop. Not a huge effect. Certainly, it seems likely that they might have made considerably more than .1% more farmland per year by draining swamps. On the other hand, growing from 5 to 8 million in a century is not really much of a rate; an average yearly increase of .4%. So, draining off 1/4 of that increase is something.

My understanding is that later on in the industrial revolution, transportation made a big difference in food availability, but here I am thinking about canals and then railroads. I am not aware of any earlier revolutions in land transport, although in Britain, many places are near enough to the sea that they might benefit from cheaper naval transport. Are there records of food imports? I suppose there must have been roadbuilding of various sorts in Britain that would have made incremental differences which could have added up in quantity.

One aspect of horses as capital is that you can grow them on marginal land, including land that is too far from a transport net to grow anything for market. They can walk to market. I would guess that horses probably died off in droves in London, and were then eaten or turned into glue. So new horses would have been coming in continually from outside.

It does seem to me that the umbrella of "malthusian" is covering several related but distinguishable concepts. One is a discussion of human well-being, and there horses just don't count. The X axis is of interest analytically, but the Y axis is what we really care about. But another sense is in a discussion of economy, that is, the entirety of the human-controlled part of the biosphere. And there, counting is hard. It might be interesting to not pick an arbitrary number for animal-weighting, but rather, attempt to find a number for animal-weight such that the graph for all societies (herding and not) up to 1500 or whatever is as flat a line as possible. This might help to pinpoint more closely where the Britons actually "took off".

8:51 PM

nick said...

Leonard, thanks for the thoughtful and though-provoking comments. I tend to think of emigration as a Malthusian equivalent to plague, and the 17th century emigration was about 1/7th the percentage of the 14th century Black Death. What generally happens in a plague or emigration is to slide up the Malthusian isocline (i.e. less population and higher per capita income).

If there is a "brain drain" that might regress the isocline itself, as could short-term disruptions to various relationships and institutions, but I suspect such effects are generally short-term. In the short-term the isocline can regress and progress quite rapidly due to temporary outbreaks of crop or livestock diseases, poor weather, etc. so it's very hard to track any underlying progress or regress before the British breakout era except over long periods. I have created a graph (this time directly calculated from statistics) that by using 80-year chunks smooths out most weather and pest problems and as a result demonstrates non-regressing progress from each 80-year interval to the next from 1200 to 1900 -- including through the Black Plague. (The plague radically changes the position on the isocline of course, but the isocline itself is still above and to the right of the prior). Contrast to Clark's graph that jumps all over the place before the 1800s -- the difference is that he's using 10-year intervals that are dominated by variations in harvests due to weather and pests.

There are records of food exports and imports. Up to the 18th century they tended to export food, but not much. More importantly Britain exported lots of wool and goods made out of native wool, an activity that consumed considerable pasture. Food imports weren't significant until the late 1840s and not substantial until late in the 19th century. My focus tends to be on the period 1500-1840 where one can see unprecedented progress leading to breakout while Britain was fully self-sufficient in food. (There was a very interesting import earlier in the 19th century, not of food, but...but I shan't give out more spoilers :-)

You are getting very warm with your comments about horses. I've got a ton of half-written stuff that covers these kind of ideas that I hope to finish and post in the upcoming months. I better get them finished before you post them first. :-)

The best way to judge progress is by comparing to what came before, not what came after. A number of technologies that seem entirely mundane or obsolete to us were revolutionary in their day, and often as or more revolutionary than the celebrated ones (e.g. steam). For example the reclamation of 1/4 of the land -- it seems like a small growth rate to us, and quite tame compared to the settlement of the U.S., but compared to prior history expanding into and improving so much marginal land (a far harder thing than pioneering very good land in the American Colonies) in so little time was unprecedented. Most of this was land that had been pasture or waste for several thousand years of agricultural history and now in the space of a century they're all over it, and even more spectacularly pioneering marginal land without reducing overall yield per acre or labor productivity.

So my strategy has been to put aside (but not discard) the celebrated "revolutions" and focus rather on the humble things that actually made the biggest differences down on the farm. Many of the most important revolutions took place in the sticks, out of the radar range of the people who wrote the histories.

10:40 PM

Leonard said...

It seems to me that invention must be the key factor in the breakout: it must be the case that people are inventing (and/or adopting from afar) new technologies such that the isocline moves up/right faster than the population. If the rate at which discovery/adoption happens is fast enough, then you are out of Malthusianism. If it isn't, you go back into the trap. So getting a critical mass of brains (both quality and quantity), would have been key, as well as the political/social institutions to support invention. So, it appears the Statute of Monopolies may have been a key kickoff event.

Access to the New World does seem important, both because of the colonization effect and because of all the new "technology" that it made accessible. Mainly this is all the Indian-derived food crops, particularly maize/corn and potatoes. However, I would not be surprised if other crops were very important too. As a form of biotech, these crops must have moved up the isocline at least somewhat. So their adoption would have given that much more breathing room in getting the invention cycle going.

Also I think the very nature of their adoption might have helped to change the culture to be friendly to innovation. By Darwinian means, if nothing else: those who resisted the potato starved. Acceptance of innovation might have been a factor, although very hard to prove I think. Perhaps we might see records of patents or something go up.

One other factor worth pondering is the total size of the Anglosphere, and more generally, the West. For invention, it seems to me that the absolute numbers of men matters, since a single idea anywhere can be spread everywhere very rapidly. Here is another way in which colonization and imperialism would have been helpful: by bringing so many new minds into technological communion with the West. (Though quality does matter, and certainly the story of human intelligence is related here.)

I can see why reclaiming land in Britain would be far superior to colonization: any such land created would very likely be easy to hook into the existing transportation network there. So, doing this would tend to push up/left on the isocline, creating more breathing room to wait for the innovation kickoff. By contrast, as you say, colonization into remote places would tend only to be sustenance, which would not move the society on the isocline much or at all, and might even push back the isocline slightly if you consider colonization to be moving backwards in technology.

10:58 AM

Eric Johnson said...

> Unlike any other organisms human or otherwise who have ever lived on this planet.

This is not quite so, I think, and I hope an excursion will not be found too irrelevant. As I have discussed with TGGP, many animals have very high food-production labor efficiency. Or so I would speculate. Tropical frugivorous birds, for example. Ruminants which must chew and to a lesser extent graze all day because of their low-nutrition-density food are at the other end of the scale.

I would suspect that a lot of animals are metaphorically-malthusian, but not strictly: there is enough food for them, generally, but

not necessarily enough of it in places where predation risk is low, because visual or aural or steric cover is sufficient, and there are not too many vantages/blinds where predators can detect especially much better than they can be detected.

In tropical birds, including USA-breeding taxa that winter in the tropics, but more especially in non-migratory tropical birds, you see a lot of complexity displays, from plumage to stereotyped movement sequences. Because they involve intricate interaction of numerous gene products, these complexity display phenotypes are very sensitive to being messed up by modest amounts of mutations in those genes - as are vertebrate immune systems, I would suspect. The complexity displays are also associated with metabolically expensive ornamentation - expensive to construct, and expensive to carry - and are also associated with high female effort in inspection and choice of multiple potential mates. It's widely believed that the complexity displays are found in taxa where fitness variance is largely a function of resistance to acute and chronic parasitisms of both high and low virulence. The complexity displays, then, probably show a relatively unmutated genome and immune system, while the costly ornaments show a lack of fatiguing illness. These animals are probably the least malthusian, in any literal or even extended sense. Nor are they strongly impacted by, or resistant to, predation, since some of the highly-ornamented birds, for example, fly and maneuver with a risibly little facility. Their life not really a quest for nutrition; it's more of a chase-flight-chase-flight through genome sequence space, as parasites gain resistance to host antimicrobial proteins, for example, and new ones evolve - plus, at the same time, their life is a constant, vigorous quest for the purgation of mutations, mediated by complexity displays and high male-reviewing effort by females.

Why more parasites in the tropics? The reason for higher biodiversity in the tropics is still debated. More parasites may just be part of this higher biodiversity. Arthropod vectors are probably more diverse if not necessarily more numerous. And William McNeill in "Plagues and Peoples" suggests that parasites in the tropics can survive longer outside of a host, making the game that much easier.

7:08 AM

Eric Johnson said...

> Now it occurs to me that some land might be too marginal to farm for subsistence: it's only economical to farm for sale to a market. So better transportation would lead to more reclamation

I could be missing a subtlety but I don't see how this can be. Work that yields too little money/food for subsistence cannot be done - at least not if we assume that it sustains those doing the work, at the same level of population, over generations (which I assume is what subsistence means).

There could be other connections, though. What if there are some separated patches whose yield is unacceptable if traveling on foot, but good if one has a horse to get from one to the other. (I'll assume the horse is nearly a free lunch, because there is land that can support it but cannot support human food or tradeable goods like wool.)

Or, suppose an entire farm is only good for wool, not food. Or only grain, and no other food - or only greens. (Maybe you can grow grain on it, but not nearly enough to make it worthwhile.) If you can't get a complete diet from the land, then you can't live on that land without trade. If transport distance/efficiency increases, then some such lands could be reclaimable, because under the prior transportation regime, one could not obtain complimentary trade.

7:43 AM

nick said...

Work that yields too little money/food for subsistence cannot be done

This is a good point, but I think you also answered it, namely gains from specialization. The soil of a region might not be sufficient to grow a mix of food sufficient to live off of, yet it might be sufficient to grow exportable goods which can be traded for sufficiently nutritional foods. I admit to having a tough time coming up with examples, though, as the issues are subtle. Livestock could already be driven long distances to market, so that doesn't seem a good example. Albeit sheep for wool does, as wool was cheaper to transport than grain but not nearly as cheap as driving livestock. But land was also reclaimed for grain. The gains from specializing in that are either much more subtle or requires another explanation. Your answer about more dispersed plots may be it. Langton

mentions commuting from village to farm as an advantage of a horse in his pathbreaking book on the English transition from ox to horse, but doesn't relate it to reclamation. To your answers I'd add gains from transporting inputs _to_ the farm: e.g. liming and manure.

Your excursion on tropical birds is fascinating and not at all irrelevant. My interpretation is that these birds have a typical (far southwest) isocline for non-human animals. They have a far smaller population than their available food might support, so they live at the extreme top of the isocline. Which should be typical for species that have a high parasite load or predator load or (as with human hunter-gatherers) high intraspecific violence. If the parasite load disappeared I'd expect these tropical birds to evolve by sliding down the isocline, that is achieving a higher population destiny but losing the strong immune systems and wonderful plumes.

The British were different because they radically moved the isocline itself: in the space of a few centuries they greatly increased their population without a substantial decline the per capita productivity of food production, and in the final phase radically increased the per capita productivity of food production as well.

Incidentally, I've browsed Richard Wrangham's new book on cooking and homo erectus. The basic theory is that the discovery of fire and cooking allowed our homo erectus ancestors to grow bigger brains by allowing us to more easily digest a wider variety of foods. It allowed our ancestors to both decrease the size of their jaws, teeth, and digestive system (replacing them with bigger brains) and eat better diets and/or grow their population. I hypothesize that cooking was actually a substantial move northeast in the Malthusian isocline, allowing us to "predigest" food in ways other animals are not capable of. But not without animal analogs, e.g. the extra stomach of ruminants allowing them to "predigest" grass. And indeed, the high population densities of many ruminants suggest that they actually have rather northeasterly isoclines. In the case of American bison for example probably even more advanced than erectus or human hunter-gatherers.

Incidentally, I'm not sure if Wrangham deals with this, but I'd add that fire and tool use are synergistic -- rocks can be used to grind or pound food down to a certain point where cooking becomes most effective in predigesting it. Which could explain why no other animals (e.g. birds which regularly manipulate tinder) ever evolved to predigest food with fire.

11:11 AM

nick said...

Leonard, new crops are definitely good places to look at. But as it turned out the most important crop didn't come from the new world.

The most important innovations down on the farm weren't patented, but I am confident that the general culture of experimentation and improvement played a role. And more abstract science may have played a role, albeit if so in a non-obvious way, as the leading experts of the day had theories and opinions rather opposed to the most productive innovations, and any understanding either farmers or scientists had of why their innovations were working was extremely poor from our point of view which is much better informed about the science.

All fodder, as it were, for future posts.

11:25 AM

Eric Johnson said...

> My interpretation is that these birds have a typical (far southwest) isocline for non-human animals [...]

Ah yes, I understand. I hadn't thought of that.

1:29 PM

Richard said...

well, there are no advertisements in the video of China. don't know what that has to do with the Malthusian trap tho.

4:00 PM

nick said...

Richard, that's actually an intriguing observation. It reflects perhaps a difference between the societies that may have quite a bit to do with the issue. Namely, the British economy of that time probably involved far more relationships with strangers, mediated by things like advertising, than the Chinese economy of that time.

11:31 AM

Sam said...

What struck me was the amount of horse buses. If that's what you call them. Taxis? If that many people tried to move in individual carts you wouldn't be able to move.

11:27 AM

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